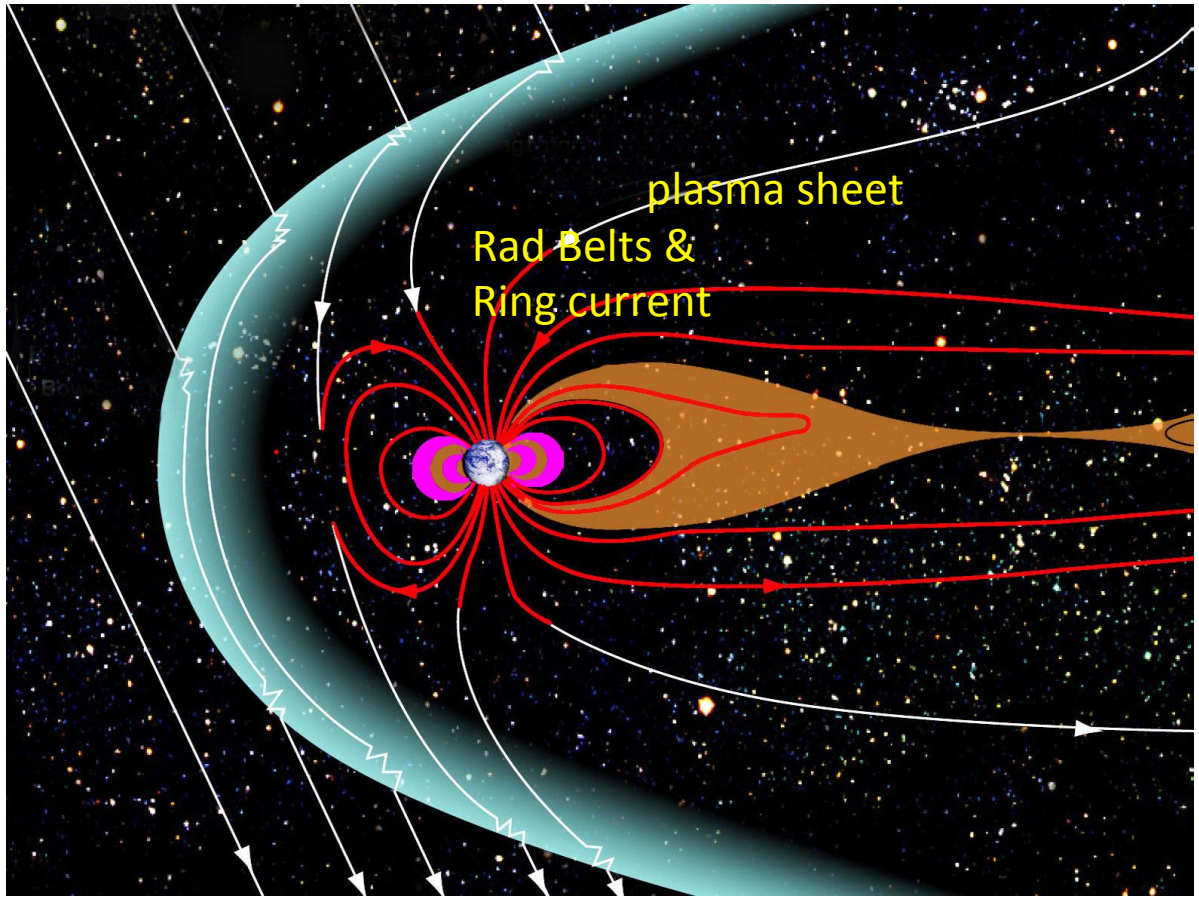
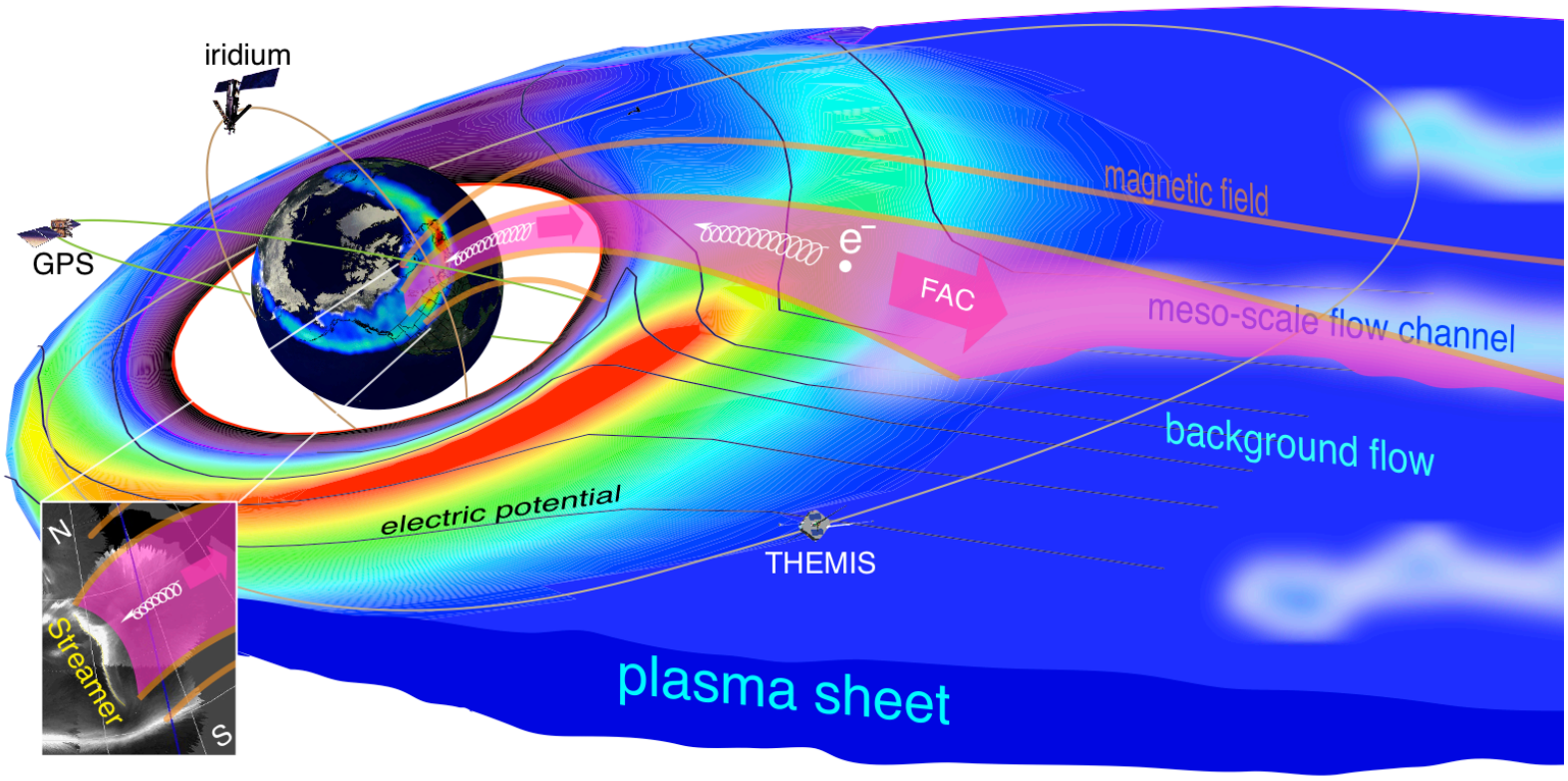
The Magnetosphere

- **Energized particles trapped on closed field lines:**
  - *plasma sheet, radiation belts/ring current*
- **Energy from solar wind**
  - *Polar magnetic field lines open to interplanetary B*
  - *Solar wind E transferred in, and then to closed region (i.e., reconnection)*



The Earth's Coupled Magnetosphere-Ionosphere System

- **Electric fields and currents couple to the conducting ionosphere**
  - *Upward currents give the aurora*
- **Plasma and field structure and dynamics of the system result from the electrodynamically coupled magnetospheric and ionospheric plasma**



Major AOS Space Plasma Activities

The Earth's Coupled Magnetosphere-Ionosphere System

Radiation belt electron formation and loss and related plasma wave observations and theory - Richard Thorne, Wen Li, Jacob Bortnik (lead Pis)

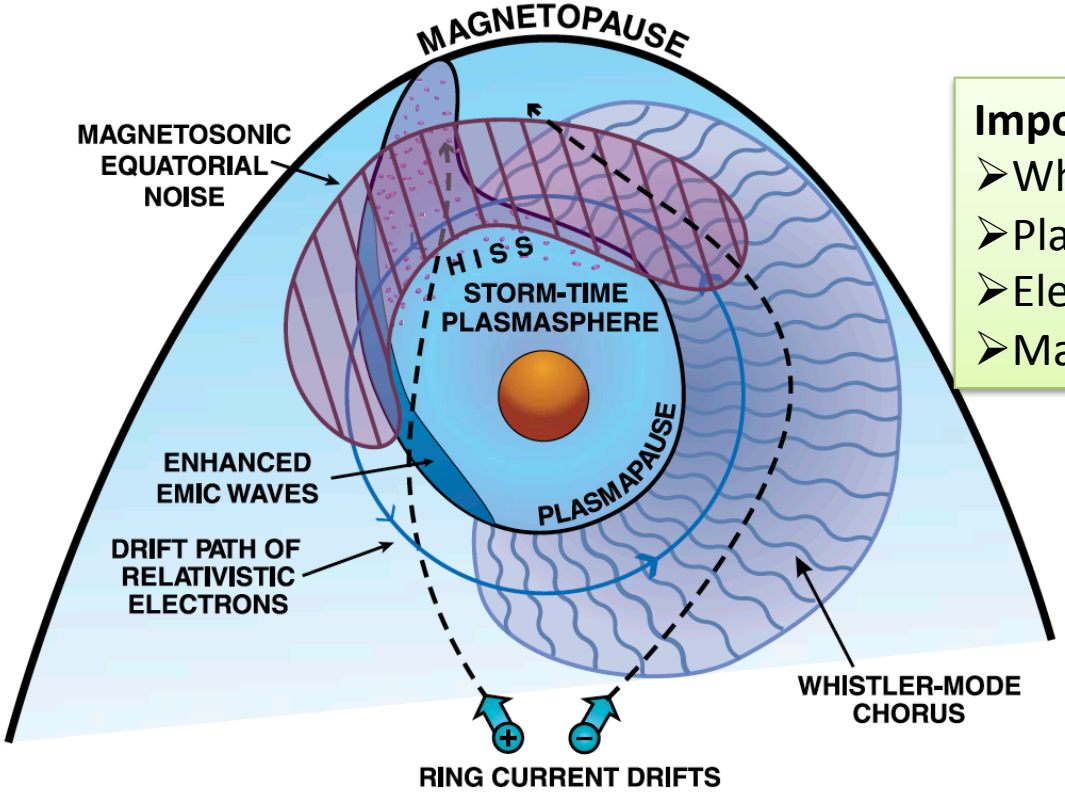
Large-scale plasma, field, current modeling of coupled system; plasma entry - Chih-Ping Wang (lead PI)

Dynamical energy transfer processes throughout the system – Toshi Nishimura (lead PI)

Major disturbances of the coupled system - Larry Lyons, Toshi Nishimura (lead PIs)

Next: Some sample topics of possible interest to plasma physics community

Wen Li: Wave-particle interaction in the radiation belts



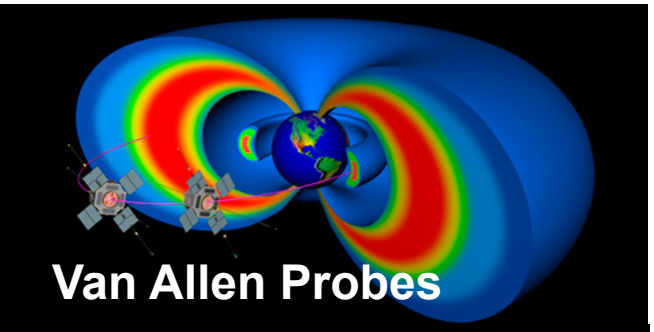
[*Thorne*, 2010]

Important wave modes

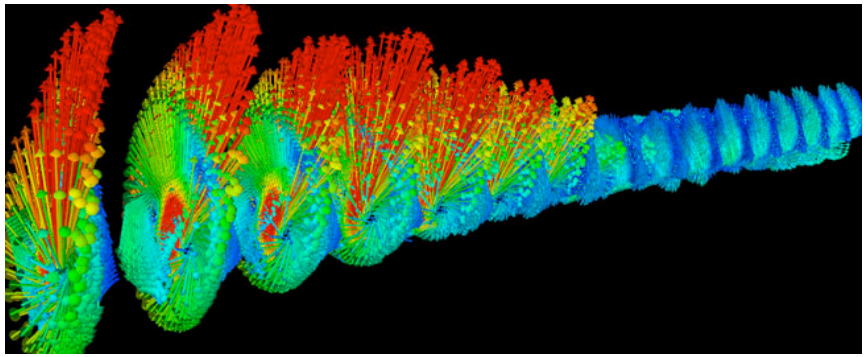
- Whistler-mode chorus
- Plasmaspheric hiss
- Electromagnetic Ion Cyclotron wave
- Magnetosonic wave

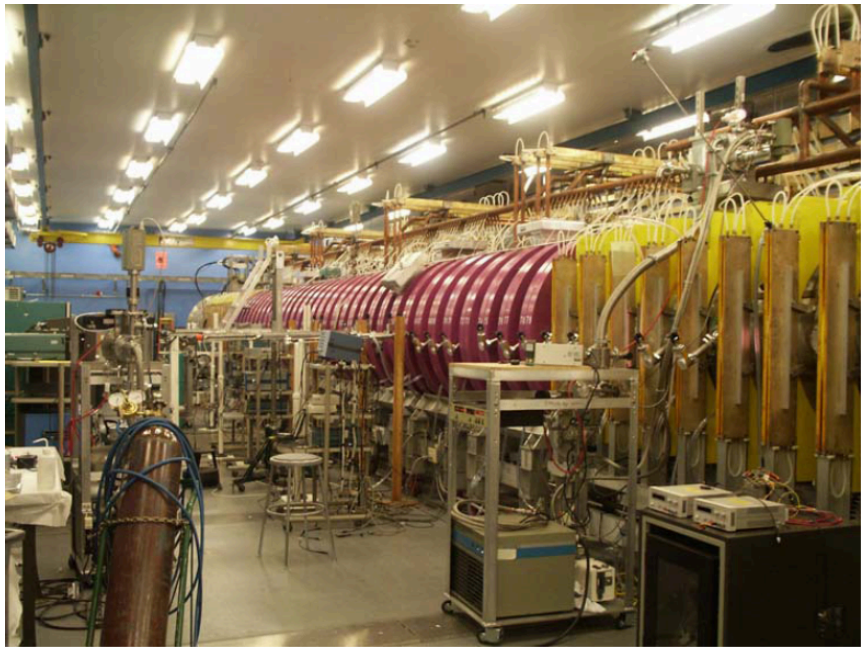
Topics:

- Evaluate wave generation mechanism and propagation characteristics
- Quantify waves role in energetic outer-belt electron dynamics under various levels of magnetic activity
- Determine particle precipitation rate from each type of wave



•Jacob Bortnik and student Xin An

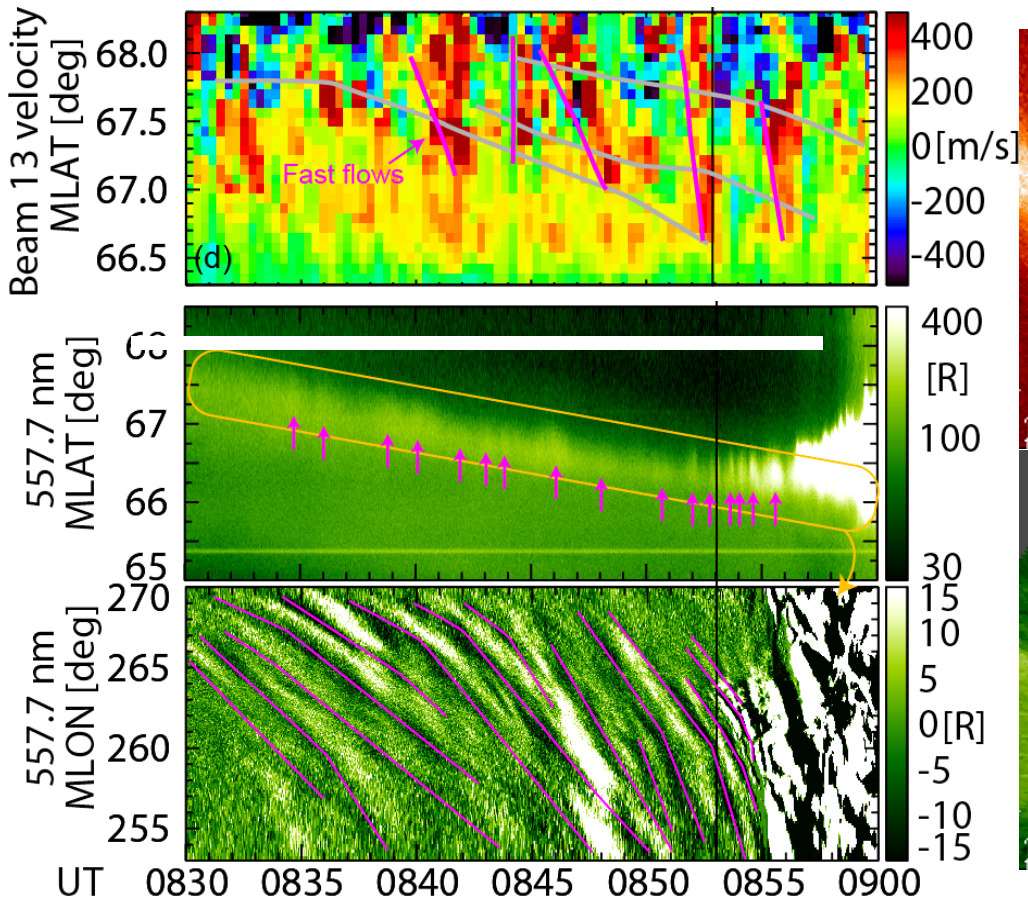


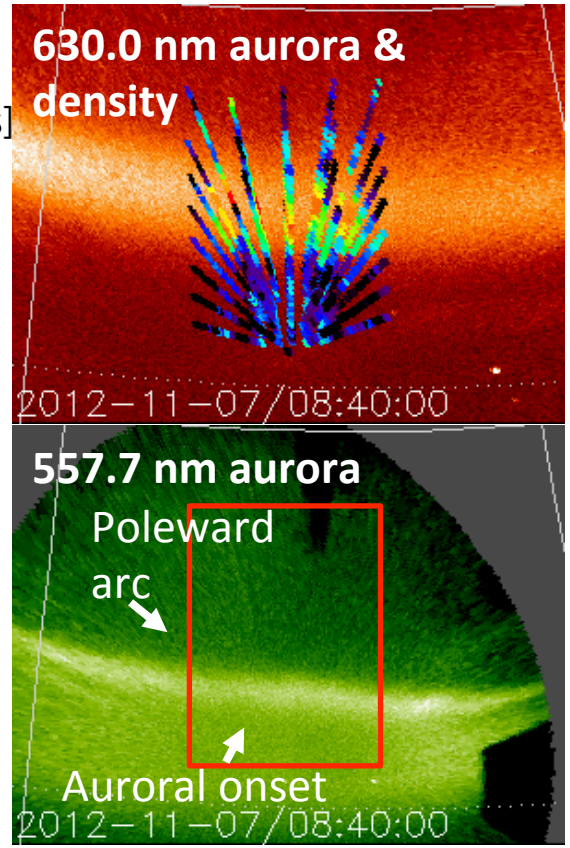


- LAPD experiment exploring whistler mode wave generation

Toshi Nishimura: Substorm triggering by flow-wave coupling

- Ground optical and radar obs. here; also THEMIS sapcecraft





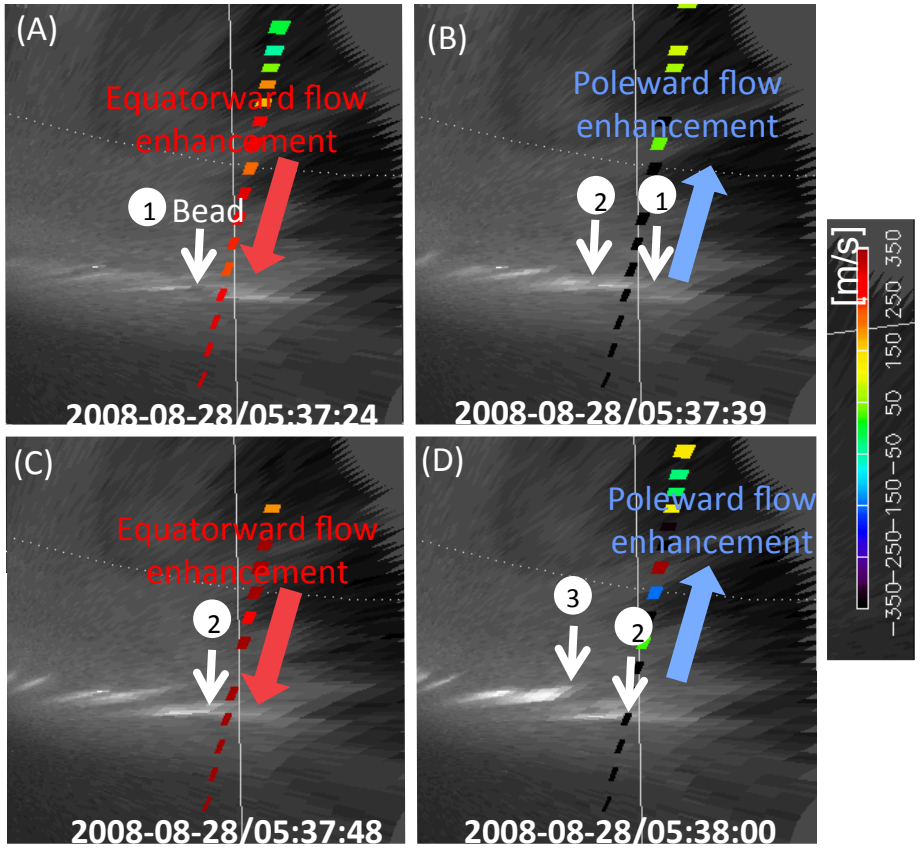
Pre-onset M-I waves develop to the onset waves

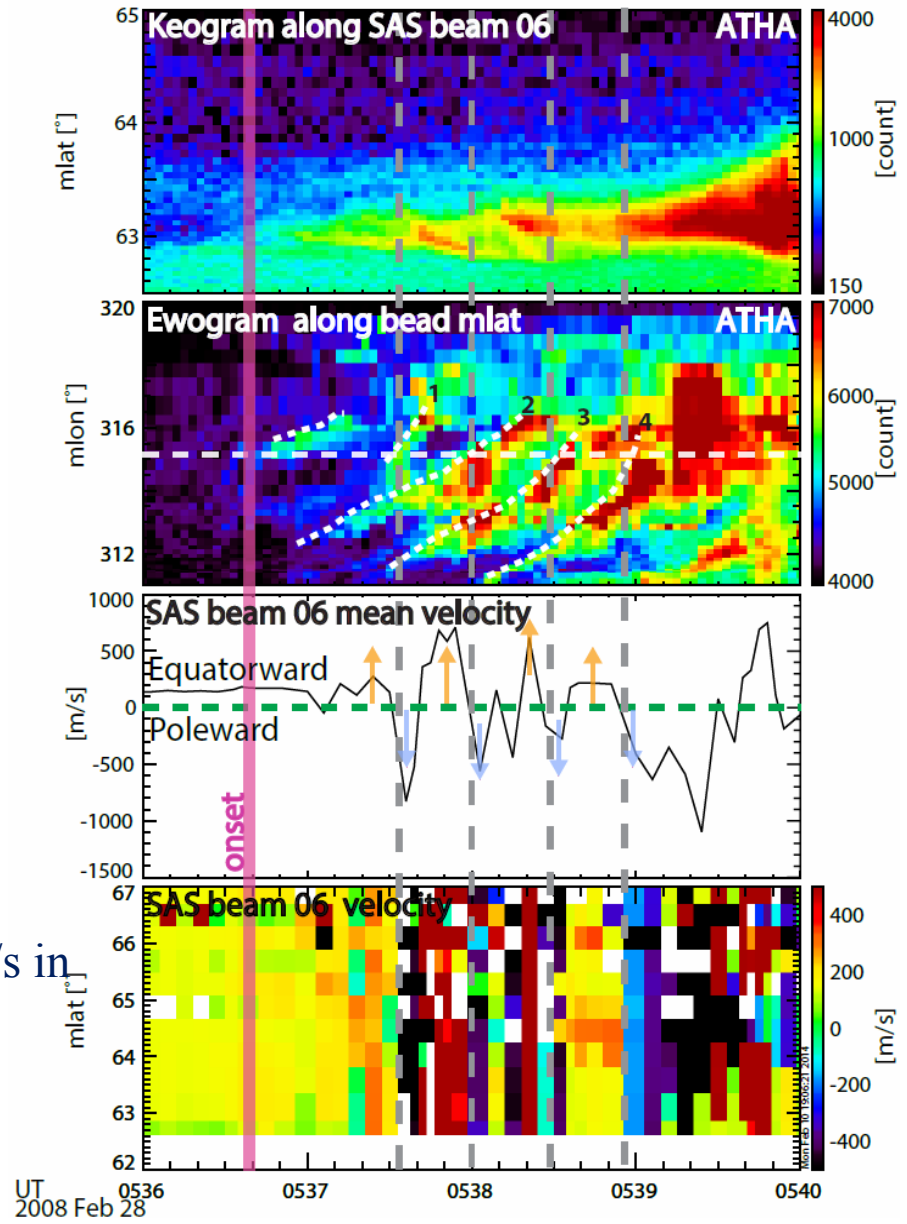
⇨ Pre-onset waves act as a seed of onset instability

Remained small but abruptly amplified when fast flows reach them

⇨ Pre-onset flow made the waves more unstable

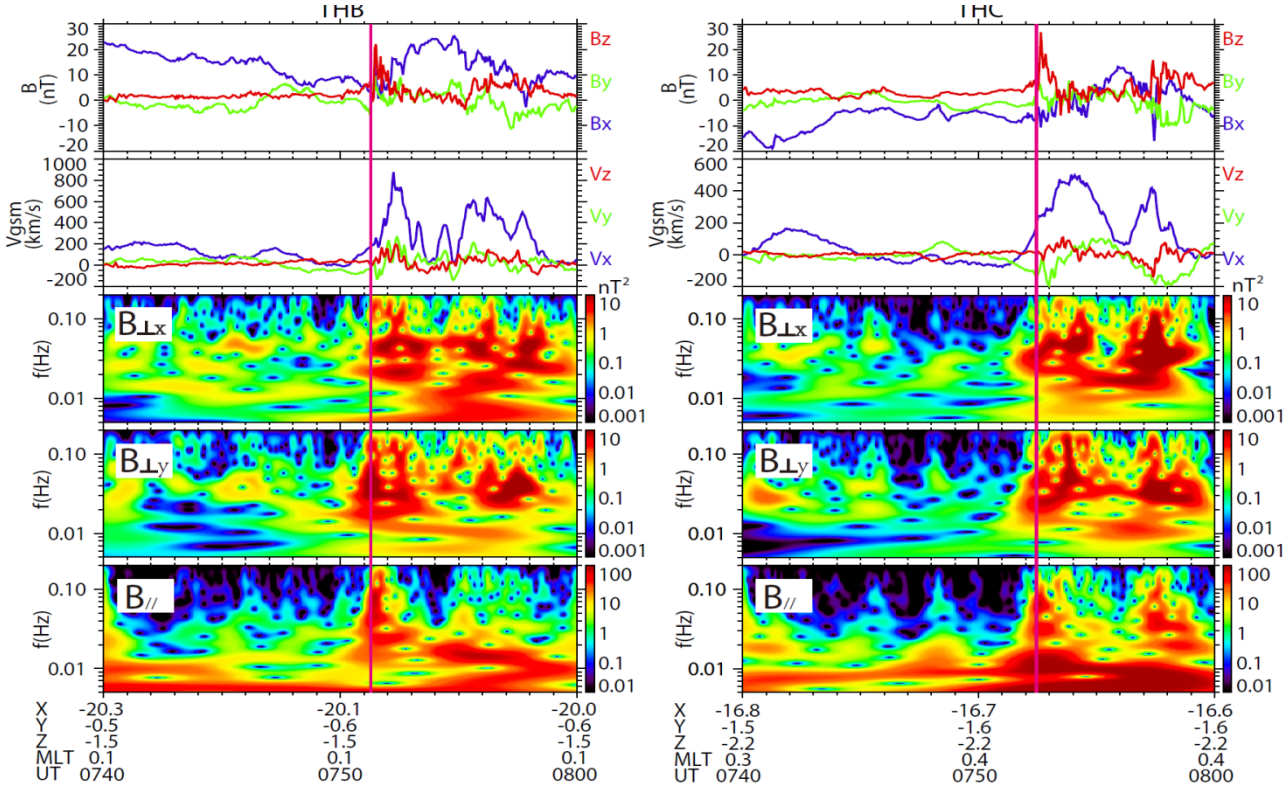
- **Toshi Nishimura with student Bea Gallardo**
- **Tremendous flow enhancement with substorm auroral onset**



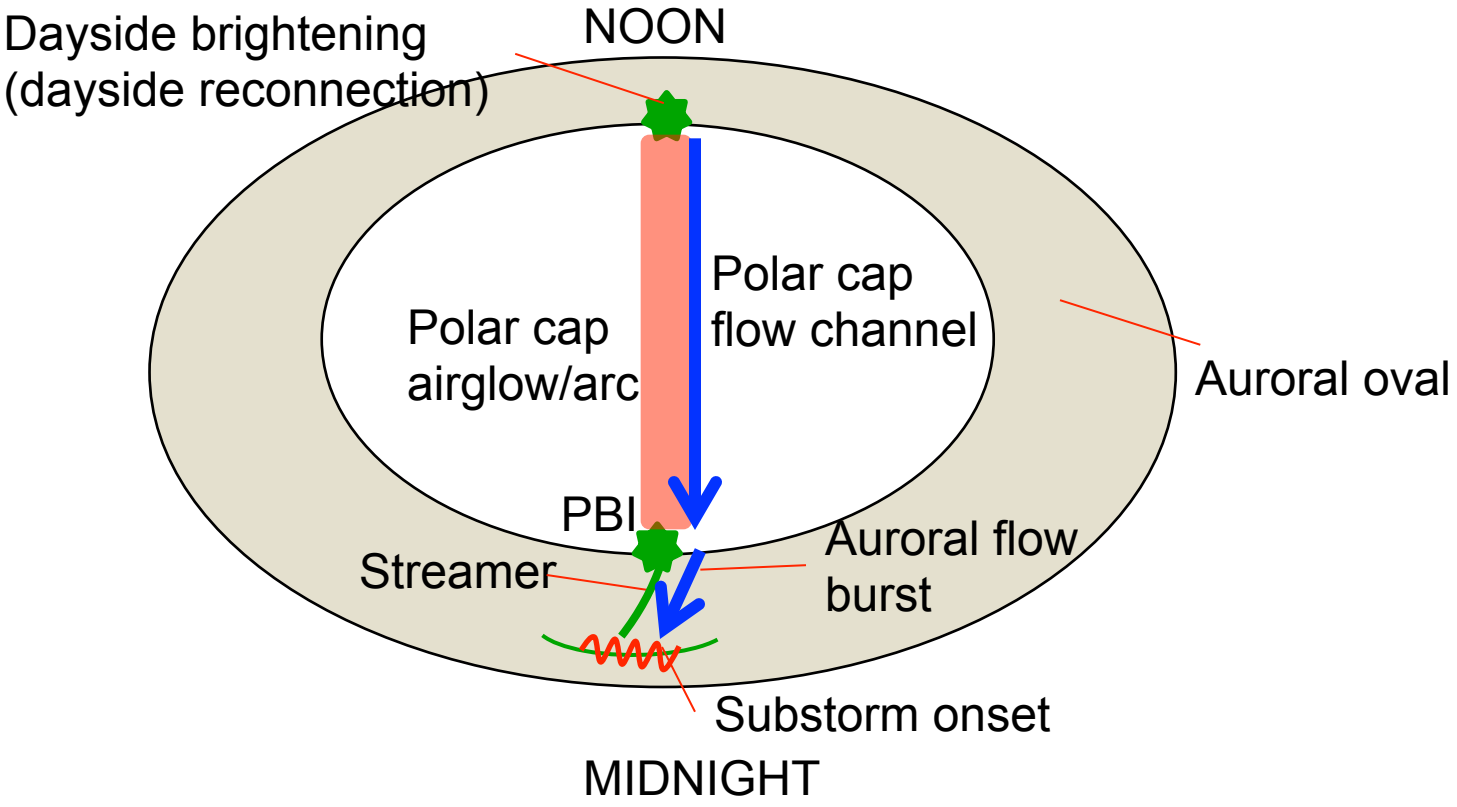


- Strong flows associated with auroral beading
- Average flow enhacnements reaches ~ 1000 m/s in magnitude
- Clockwise flow shear: Equatorward flow enhancement ahead of the bead followed by a poleward flow enhancement

Xiaoyan Xing: Ballooning instabilities in the plasma sheet



Toshi Nishimura, with Ying Zou and student Boyi Wang



- Localized fast flow channels propagate from dayside to nightside and connecting dayside and nightside transient phenomena via the polar cao.
- Suggest dayside-polar cap-nightside interaction by flow channels, having large impacts on dynamics of the M-I coupling system.
- **New paradigm: major driver of NASA Heliophysics System Observatory**